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EPOXY RESIN COMPOSITION FOR SEALING SEMICONDUCTOR  
[Handoutai Fushiyō Epokishi Jushi Soseibutsu]

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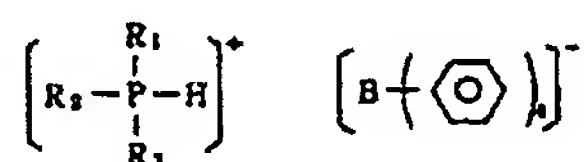
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## 1. Title of the Invention

Epoxy Resin Composition For Sealing Semiconductor

## 2. Claims

1. An epoxy resin composition for sealing semiconductors, wherein a tetraphenylborate trialkylphosphine is used that is expressed by



[in the formula,  $R_1$ ,  $R_2$ , and  $R_3$  are alkyl radicals with carbon number 2-10] as a curing agent in an epoxy sealing composition which cures a novolak phenol resin.

## 3. Detailed Description of the Invention

[Field of the Invention]

This invention is related to an epoxy resin composition used for sealing, using a transfer formation method, so-called semiconductor element types, such as transistors, IC and LSI.

[Prior Art]

The transfer formation method is generally used with epoxy resin from the economic point of view for sealing various types of semiconductor elements, such as transistors, IC, and LSI, and because the system which uses novolak epoxy resin and phenol resin as a

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\* Numbers in the margin indicate pagination in the foreign text.

curing agent is the best at preventing moisture, it is the system that is currently principally used.

On the other hand, in order to improve productivity in the formation process, the formation process is made highly cyclic, as the formation time is made shorter, the cured substance directly after formation becomes soft and formation workability is degraded creating problems.

It is acceptable if there is only an increase in the hardening of the cured substance directly after formation and if blending of normal curing agents with resin substance occurs in quantity, but the flowability of the resin composition worsens, and furthermore, the pot life becomes shorter, creating new problems.

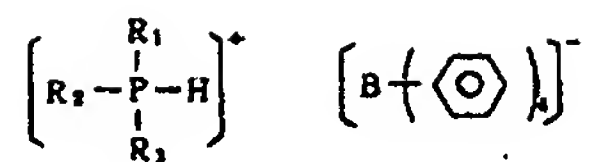
[Problems that the Invention is to Solve]

This invention is made from the previously described perspective /176 so as to obtain an epoxy resin composition used for semiconductor sealing having good curability and superior formation workability.

[Means of Solving the Problems]

The inventors obtained results after diligent investigations to solve the previously described problems arriving at the present invention by discovering that the problems could be solved by using trialkylphosphine tetraphenylborate as a curing agent.

That is, the present invention is an epoxy resin composition for sealing semiconductors wherein a tetraphenylborate trialkylphosphine is used that is expressed by



[in the formula,  $R_1$ ,  $R_2$ , and  $R_3$  are alkyl radicals with carbon number 2-10] as a curing agent in an epoxy sealing composition which cures a novolak phenol resin.

More specifically, the curing agent can be tetraphenylborate having as radicals  $R_1$ - $R_3$  as ethyl, butyl, hexyl, octyl, cyclohexyl,  $R_1$ , as ethyl,  $R_2$  and  $R_3$  as butyl,  $R_1$  as butyl and  $R_2$  and  $R_3$  as cyclohexyl,  $R_1$  as cyclohexyl, and  $R_2$  and  $R_3$  as butyl radicals.

For the blending weight of the previously described curing agent, letting the epoxy resin be 100 wt. parts, the blending weight can be suitably chosen as 1-4 wt. parts, preferably 2-3 wt. parts. It is possible that the curing agent can be used independently or with other curing agents in proportions which do not adversely affect the curing properties.

The epoxy that is used with the present invention is an epoxy made by glycidyl etherizing, using epichlorohydrin, with the raw material of a resin obtained by condensing with an acidic catalyst using formaldehyde and phenol, cresol, bis-phenol A and the like. To give superior strength an epoxy equivalent at 170-300 is suitable and a range from 180-200 is preferable.

The novolak phenyl resin used as a curing agent is a resin obtained by condensing using an acidic catalyst, phenol, cresol, bis-phenol A and formaldehydes and the phenolic hydroxyl per single epoxy

radical contained in the epoxy resin is used in a ratio of suitably 0.5-2.0 or preferably 0.8-1.2.

The composition of the present invention can contain fillers. The filler that may be used can be the following: silica, glass, diatomaceous earth, calcium carbonate, alumina, barium sulfate and the like with silica and glass having superior electrical properties. The weight that is used for the fillers is preferably in the range of 100-500 wt. parts with respect to 100 wt. parts for the epoxy resin. When the amount used is less than 100 wt. parts, moisture resistance suffers, and when more than 500 wt. parts is used, flowability is lost so amounts outside the 100-500 wt. parts range are not desirable.

This composition can use release agent, colorants, fire retardants, fire retardant aids, couplers and the like. Especially, couplers are important for effectively bringing out the results of fillers, and for example, such fillers as  $\gamma$ -glycidoxypropyltrimethoxysilane,  $\beta$ -(3, 4-epoxycyclohexyl)-ethyltrimethoxysilane and the like can be used.

The epoxy resin composition can be manufactured by a blending method while heating the previously described epoxy resin, curing agent, curing promoter, filler, coupler, and the like using a mix roll.

The obtained epoxy resin composition is formed by such methods as transfer formation and cast molding.

## [Embodiments]

An explanation is given below for the present invention using embodiments, but the scope of the invention is not limited by these embodiments.

### Embodiment 1

Using cresol novolak epoxy resin (epoxy equivalent 195) 100 wt. parts, novolak phenyl resin 50 wt. parts, silica powder 350 wt. parts, tributylphosphine tetraphenylborate 5 wt. parts,  $\gamma$ -glycidoxypentyltrimethoxysilane 2 wt. parts, carbon black 1 wt. part, and carnauba wax 2 wt. parts using a 10 inch mix roll and mix for 6 minutes following the sequence of pre-rolling at 80°C, post roll at 30 °C, pre-roll at 22rpm, and post roll at 18rpm. Pulverize the obtained sheet-shaped substance to obtain an epoxy resin composition used for sealing semiconductors. /177

### Embodiment 2

Obtain an epoxy resin composition for sealing semiconductors by the same method as used in Embodiment 1 except for using phenol novolak epoxy resin 100 wt. parts (epoxy equivalent 180) and novolak phenyl resin 55 wt, parts.

### Embodiment 3

Obtain an epoxy resin composition for sealing semiconductors by the same method as used in Embodiment 1 except for using tributylphosphine tetraphenylborate 4.5 wt. parts as a curing agent.

#### Comparative Example 1

Obtain an epoxy resin composition for sealing semiconductors by the same method as used in Embodiment 1 except for using 8-diazabicyclo (5,4, 0)undecene 1.5 wt. parts as a curing agent.

#### Comparative Example 2

Obtain an epoxy resin composition for sealing semiconductors by the same method as used in Embodiment 1 except for using 2, 4, 6-tris dimethylaminomethylphenyl 1 wt. parts as a curing agent.

#### Comparative Example 3

Obtain an epoxy resin composition for sealing semiconductors by the same method as used in Embodiment 1 except for using 2-methylimidazole 1 wt. part as a curing agent.

#### Comparative Example 4

Obtain an epoxy resin composition for sealing semiconductors by the same method as used in Embodiment 1 except for using tetrabutylphosphonium-tetraphenylborate as a curing agent.

Table 1 shows the resin properties of each of the compositions.

Here, the spiral flow and gelling time were measured at 180°C, and the hardness was measured as Shor D while heating directly after forming by a transfer press and DILP die at a formation temperature of 180°C, formation pressure 70 kg/cm<sup>2</sup> for 90 seconds.

The epoxy resin composition used for sealing semiconductors which used the tetrabutylphosphonium-tetraphenylborate as a curing



agent as is clear from Table 1 had great hardness with superior flowability and curability.

Table 1

e 組成	a 性質	ゲル化時間		c スパイラルフロー (インチ)	d 硬度 (ショアD)
		b (S)			
f 実施例	実施例 1	27		50	85
	実施例 2	24		54	84
	実施例 3	25		48	84
g 比較例	比較例 1	26		54	67
	比較例 2	24		47	75
	比較例 3	26		39	71
	比較例 4	33		69	75

Key:

- a) Properties;
- b) Gelling time (S);
- c) Spiral flow (inches);
- d) Hardness (Shor D);
- e) Composition;
- f) Embodiment;
- g) Comparative example.

#### [Effect of the Invention]

When sealing semiconductors using the present invention's epoxy resin composition, a remarkable improvement in formation workability was obtained. The industrial value of the present invention is remarkably high.